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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/817,611	04/02/2004	Sheng Sun	A7188/T47800	2449

57385 7590 08/19/2009

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EXAMINER	
HORNING, JOEL G	

ART UNIT	PAPER NUMBER
1792	

MAIL DATE	DELIVERY MODE
08/19/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/817,611	SUN ET AL.	
	Examiner	Art Unit	
	JOEL G. HORNING	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 April 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11,15-24,28,29 and 33-43* is/are pending in the application.

4a) Of the above claim(s) *34-43* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11,15-24,28,29 and 33* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Status of Claims

1. Claims 1-11, 15-24, 28, 29 and 33-43 are currently pending. Claims 34-43 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on June 30th, 2008. Claims 1, 2, 17 and 21 have been newly amended and **claims 1-11, 15-24, 28, 29 and 33** are pending for action on their merits.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. **Claims 1-11, 15-24, 28, 29 and 33** are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 1, 2, 17 and 21 have been amended to require flowing "an inorganic process gas mixture" however, the specification does not specifically contemplate "inorganic process gas mixtures." Applicant has support for using a process gas mixture which includes silane and nitrous oxide as process gases, but that does not support the broad claim of all inorganic process gas mixtures in applicant's process.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. **Claims 1-8, 10, 11, 15-19, 21-24, 28 and 29** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reichert et al (US 5814565) in view of Iturralde (US 5955139) in view of Cheung et al (US 5968324) in view of Nguyen et al (US 2003/0008500).

The instant **claim 1** is directed towards a method for processing a film over a substrate in a process chamber, the method comprising:

Flowing an inorganic process gas mixture in the process chamber in accordance with a predetermined algorithm specifying process conditions;

Monitoring a parameter during processing of the film over a thickness greater than 3 microns; and

Changing the process conditions in response to a measured optical property of the film, wherein changing the process conditions comprises increasing, **discretely**, an RF source power.

The instant **claim 21** has the same limitations as claim 1, but requires that the RF source power be increased in a **continuous** fashion instead of a discrete fashion.

Reichert et al is directed towards a process for forming optical waveguides by depositing silicon oxynitride films. The process comprises placing a substrate in a RF plasma reactor and flowing an inorganic process gas mixture, specifically, silane and nitrous oxide **(claim 17)** into the process chamber with an RF plasma (it is a plasma enhanced process) **(claim 2)** in order to deposit the desired films **(claim 18)** (col 6, lines 45-64). During deposition, the gas flow rates are controlled (col 5, lines 63-67) in order to modify the index of refraction of the film (col 5, lines 5-9).

Regarding the thickness limitation of the waveguide, Reichert et al teaches that the silicon oxynitride films are generally *about* 0.3-5 microns thick (col 3, lines 7-9), which includes values that are slightly higher than 5 microns, which overlaps with applicant's claimed range of greater than 5 microns **(claims 3 and 22)**. MPEP 2144.05 states: “In the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a prima facie case of obviousness exists.”

Additionally, Reichert et al teaches that the thickness of the waveguide is chosen to provide internal propagation of the light in 1-4 modes (col 3, lines 9-11), the coupling modes used is taught to depend upon the index of refraction of the material and the

wavelength of light that is to be propagated (col 11, line 65 through col 12, line 14), so the desired waveguide thickness will be determined by the wavelength of light that is to be guided.

Thus, it would have been obvious to one of ordinary skill in the art at the time of invention to choose the instantly claimed ranges of “greater than 5 microns” through process optimization, since it has been held that when the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. See In re Boesch, 205 USPQ 215 (CCPA 1980) **(claims 3 and 22)**.

Reichert et al does not specifically teach monitoring an optical property of the film during deposition or modifying the processing parameters in response to it. However, Iturralde is also directed towards the deposition of films with desired and controlled indices of refraction (abstract). It teaches that conventional film deposition processes are run with test wafers which are characterized outside the deposition chamber in order to determine the best film deposition conditions. This is taught to be time consuming and inefficient (col 1, lines 23-48). In order to overcome this problem, Iturralde teaches that an automatic thin film deposition control method and system should be used to achieve greater accuracy and shorter deposition cycles (col 3, lines 7-13). Specifically, this includes monitoring the optical properties of the film that is being deposited through ellipsometry **(claim 10),** and using a closed loop control system to modify the gas flow rates in order to deposit material with the desired thickness and/or refractive index set point **(claim 6-8)** (col 3, lines 18-42).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to monitor the optical properties of the film being deposited and control the processing parameters in response to the measured values in order to deposit films with greater accuracy and more efficiently.

Reichert et al in view of Iturralde does not teach modifying the RF power in response to the measured optical property.

However, Cheung et al is also directed towards depositing silicon oxynitride films for optical devices by a plasma enhanced deposition process (col 2, lines 49-55), which, like Reichert et al, uses silane and nitrous oxide as the process gases and modifies the process parameters in order to produce the desired index of refraction for these films (col 2, line 64 through col 3, line 6). Also like Reichert et al it teaches that the index of refraction can be controlled by modifying the gas flow rates, but unlike Reichert et al it also teaches that the refractive index of the deposited films can be controlled by modifying the RF power of the process during deposition (col 6, lines 20-50, as shown in figure 4).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to additionally modify the RF source power during the deposition process of Reichert in view of Iturralde (including increasing or decreasing it) as a method known to the art to further control the index of refraction in the produced films, which would produce predictable results.

Regarding applicant’s further limitation that the source power be modified “discretely," Iturralde teaches that the process controller controls parameters in

accordance with one of the several known control processes (col 8, lines 50-55), but it does not detail what these control processes are or whether they are discrete or continuous.

However, Nguyen et al is directed towards methods for controlling plasma enhanced CVD processes [0002], it teaches that these processes are conventionally performed in a continuous fashion, in order to apply large amounts of power and deposit films quickly [0004], this means that the power is not discretely applied, but is varied in a continuous fashion, both when it is increased or decreased.

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to continuously vary the RF power level, including by increasing it, since this is the conventionally known control method and has the advantage of allowing films to be quickly deposited **(claim 21)**.

Nguyen et al further teaches a process of discretely controlling the power application (on and off multiple times) to the RF generator in order to produce a pulsed plasma for the CVD process [0009]. It teaches that by discretely controlling the RF power application in this discrete fashion it is possible to have a tighter control of radical production ratios in the plasma, the ion temperature and the charge accumulation on the substrate. This improves the precision of the deposition and avoids damage to the wafer due to charge accumulation [0014].

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to vary the RF power discretely in pulses, including by turning the power on

(increasing it), in order to improve the precision of the deposition and avoid charging damage to the substrate **(claim 1)**.

4. Regarding **claims 4, 5, 23 and 24**, the film produced with the control algorithms of claims 1 and 21 will have vertical and horizontal profiles. Thus, as the algorithm controls deposition to produce the desired "optimal" film, they will inherently control the vertical and horizontal profiles of the deposited film to be "optimal" profiles.

5. Regarding **claim 11**, though Reichert et al does not teach controlling the film stress, Cheung et al also teaches depositing silane oxynitride using a similar process and teaches that stress in the film can cause damage to the uniform film and teaches the desirability of controlling the film stress (col 3, lines 2-17).

   Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to control the film stress so that it is also uniform and low in order to avoid damage to the substrate while producing a uniform film.

6. Regarding **claims 15 and 28**, Reichert et al teaches an embodiment where the deposited film has a uniform refractive index “n_2” (col 4, lines 35-39).

7. Regarding **claims 16 and 29**, Reichert et al teaches an embodiment where on the substrate is deposited a thin layer region with the appropriate optical properties to act as a waveguide and on top of this region is deposited a thicker layer with different optical properties so that incident light is evanescently coupled into the thin film waveguide region of the deposited film through the thick film (col 3, lines 35-43).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to create this structure by controlling the optical properties of the film during deposition to create these distinct regions as taught by Reichert et al.

8. Regarding **claim 19**, Reichert et al further teaches etching the deposited film (col 6, line 65 through col 7, line 2).

9. **Claims 4, 5, 23 and 24** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reichert et al (US 5814565) in view of Iturralde (US 5955139) in view of Cheung et al (US 5968324) in view of Nguyen et al (US 2003/0008500) as applied to claim 8 above, and further in view of Chouinard et al (US 5042895).

Though Reichert et al in view of Iturralde in view of Cheung et al teach producing a waveguide with a uniform refractive index, they do not specifically teach controlling for the vertical or horizontal refractive index profile of the film.

However, Chouinard et al discloses that the vertical and horizontal profiles of a waveguide will affect the guided optical mode shape of the waveguide during use (col 26, lines 55-60).

Thus it would have been obvious to one with ordinary skill in the art at the time of invention to control the deposited film's refractive index through the algorithm to optimize the vertical and horizontal profiles of the refractive index since these vertical and horizontal profiles are known to be important for the operation of the waveguide.

10. **Claim 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over Reichert et al (US 5814565) in view of Iturralde (US 5955139) in view of Cheung et al (US

5968324) in view of Nguyen et al (US 2003/0008500) as applied to claim 8 above, and further in view of Farrell et al (applied Surface Science **86** (1995) 582-590).

As discussed previously for claim 8, ellipsometry measurements are used to monitor the optical properties of the growing films in order to determine the film thickness, but Reichert et al in view of Iturralde in view of Cheung et al does not teach using reflectometry measurements for this function.

However, Farrell et al is also directed towards optical monitoring of growing films. It specifically is a proponent of using laser reflectometry techniques for this purpose (abstract). Ellipsometry is also taught to be a useful monitoring technique, but Farrell teaches that laser reflectometry techniques are simpler, have less demanding system requirements and use less expensive components (page 583, introduction).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to use reflectometry monitoring techniques instead of ellipsometry monitoring techniques since they were known to the art to be suitable monitoring methods and are simpler, less demanding and require less expensive components to implement than ellipsometry monitoring techniques **(claim 9)**.

11. **Claims 20 and 33** are rejected under 35 U.S.C. 103(a) as being unpatentable over Reichert et al (US 5814565) in view of Iturralde (US 5955139) in view of Cheung et al (US 5968324) in view of Nguyen et al (US 2003/0008500) as applied to claim 1 above, and further in view of Ojha et al (US 5904491).

As discussed previously, Reichert et al in view of Iturralde in view of Cheung et al teach a process of depositing a waveguide structure by plasma deposition with hydrides (silane, ammonia) and nitrous oxide (Reichert et al , col 6, lines 55-58), But does not teach then annealing the deposited film.

However, Ojha et al teaches that in waveguide structures plasma deposited films made from hydrides and nitrous oxide often have unwanted chemical substances, such as radicals, which lead to imhomogeneities in the refractive index of the waveguide material. In order to reduce these imperfections and improve the quality of the waveguide, it teaches annealing the deposited film (col 1, lines 10-32).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to anneal the deposited films in order to reduce inhomogeneities in the refractive index of the waveguide.

Response to Arguments

12. Applicant's arguments with respect to claims 1-11, 15-24, 28, 29 and 33 have been considered but are not convincing in view of the new ground(s) of rejection necessitated by amendment.

Conclusion

13. No current claims are allowed.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL G. HORNING whose telephone number is (571) 270-5357. The examiner can normally be reached on M-F 9-5pm with alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael B. Cleveland can be reached on (571)272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. G. H./
Examiner, Art Unit 1792

/Michael Cleveland/
Supervisory Patent Examiner, Art Unit 1792